

## PATENT APPLICATION

09-12-00

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IN THE U.S. PATENT AND TRADEMARK OFFICE  
Express Mail Label No.: EL 482 000 147 US  
Attorney Docket No.: Yanagihara Case 52  
September 11, 2000

Box Patent Application  
Assistant Commissioner for Patents  
Washington, DC 20231

Sir:

Transmitted herewith for filing is the patent application of:

Inventors: (1) Motohide TAKEICHI and  
(2) Hiroyuki FUJIHARA

For: COG-ASSEMBLY AND CONNECTING MATERIAL  
TO BE USED THEREIN

Enclosed are:

- [X] Specification  
[X] Declaration or Oath  
[X] 1 Drawing Sheet [X] Formal  
[ ] Informal  
[X] Preliminary Amendment Canceling Claims  
[ ] Amendment Before First Office Action  
[ ] Information Disclosure Statement  
[ ] Statement(s) re small entity (37 CFR 1.9 and 1.27)  
[X] Assignment, with Recordation Form Cover Sheet  
[X] Acknowledgment Postal Card  
[X] Priority is claimed under 35 USC 119 based on Japan  
Application No. 11-261096, filed September 14, 1999.  
[X] A certified copy of the priority application is  
enclosed.

The filing fee is calculated as shown below, after entering  
any enclosed Amendment which requests entry before such  
calculation:


| For                          | No.<br>Filed | No.<br>Extra | (X)<br>LG Entity | RATE     | ( )<br>SM Entity | Fee       |
|------------------------------|--------------|--------------|------------------|----------|------------------|-----------|
| Basic Fee                    |              |              |                  | \$690.00 | \$345.00         | \$690.00  |
| Total Claims                 | (7 - 20 = 0) |              | x \$             | 18.00    | x \$             | 9.00      |
| Indep. Claims                | (2 - 3 = 0)  |              | x \$             | 78.00    | x \$             | 39.00     |
| [ ] Multiple Dep. Claim      |              |              | +                | \$260.00 | +                | \$130.00  |
| * * * TOTAL FILING FEE * * * |              |              |                  |          |                  | \$ 690.00 |

[X] A Check for \$730.00 is enclosed to cover fees.

- [ ] Please charge my Deposit Account No. 06-1382 in the amount of \$\_\_\_\_\_. A duplicate copy of this sheet is enclosed.
- [X] The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or to credit any overpayment to Deposit Account No. 06-1382. A duplicate copy of this sheet is enclosed.
- [X] Any additional filing fees required under 37 CFR 1.16
- [ ] Any patent application processing fees under 37 CFR 1.17
- [ ] Pursuant to 37 CFR 1.52, the enclosed application is in the form of a foreign language text:
- [ ] An English translation and a statement that the English translation is accurate are enclosed.
- [ ] Please notify the undersigned of the due date for submitting an English translation and a statement that the English translation is accurate.
- [ ] An enclosed check includes the \$130.00 fee (37 CFR 1.17k) for processing a foreign language text.

Respectfully submitted,

IN DUPLICATE

  
Terryence F. Chapman

TFC/smd

|                          |                         |                 |
|--------------------------|-------------------------|-----------------|
| FLYNN, THIEL, BOUTELL    | Dale H. Thiel           | Reg. No. 24 323 |
| & TANIS, P.C.            | David G. Boutell        | Reg. No. 25 072 |
| 2026 Rambling Road       | Ronald J. Tanis         | Reg. No. 22 724 |
| Kalamazoo, MI 49008-1699 | Terryence F. Chapman    | Reg. No. 32 549 |
| Phone: (616) 381-1156    | Mark L. Maki            | Reg. No. 36 589 |
| Fax: (616) 381-5465      | David S. Goldenberg     | Reg. No. 31 257 |
|                          | Sidney B. Williams, Jr. | Reg. No. 24 949 |
|                          | Liane L. Churney        | Reg. No. 40 694 |
|                          | Brian R. Tumm           | Reg. No. 36 328 |

Encl: Listed above

100.9912

00750-0445960

PATENT APPLICATION

"Express Mail" Mailing Label No.: EL 482 000 147 US  
Date of Mailing: September 11, 2000  
Applicants: Motohide TAKEICHI et al  
Title: COG-ASSEMBLY AND CONNECTING MATERIAL  
TO BE USED THEREIN  
Serial No.: Unknown  
Filed: Unknown  
Atty Docket No.: Yanagihara Case 52



Assistant Commissioner for Patents  
Washington DC 20231

EXPRESS MAILING CERTIFICATE

Sir:

I hereby certify that the attached paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington DC 20231.

FLYNN, THIEL, BOUTELL & TANIS, P.C.

By: Hide W. Tanis

Date: September 11, 2000

Documents attached: Utility Patent Application  
Transmittal (in duplicate)  
dated September 11, 2000  
including enclosures listed thereon

Telephone: (616) 381-1156  
191.9912

PATENT APPLICATION

Express Mail Label No.: EL 482 000 147 US

IN THE U.S. PATENT AND TRADEMARK OFFICE

September 11, 2000

Applicants : Motohide TAKEICHI et al  
For : COG-ASSEMBLY AND CONNECTING MATERIAL  
TO BE USED THEREIN

Atty. Docket No.: Yanagihara Case 52

Assistant Commissioner for Patents  
Washington, DC 20231

**PRELIMINARY AMENDMENT CANCELING CLAIMS**

Sir:

Prior to calculation of the filing fee in the above-identified application, kindly enter the following:

IN THE CLAIMS

Please amend Claims 3, 6 and 7 as follows.

Claim 3, line 2; delete "or 2".

Claim 6, line 1; delete "or 5".

Claim 7, line 1; delete "any one of".

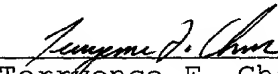
line 2; change "claims 4 to 6" to

---Claim 4---.

REMARKS

This amendment cancels claims to reduce the filing fee.  
Please enter this amendment before calculating the filing fee.

Respectfully submitted,

  
Terryence F. Chapman

TFC/smd

|                          |                         |                 |
|--------------------------|-------------------------|-----------------|
| FLYNN, THIEL, BOUTELL    | Dale H. Thiel           | Reg. No. 24 323 |
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|                          | Sidney B. Williams, Jr. | Reg. No. 24 949 |
|                          | Liane L. Churney        | Reg. No. 40 694 |
|                          | Brian R. Tumm           | Reg. No. 36 328 |

Encl: None

111.9803

COG ASSEMBLY AND CONNECTING MATERIAL  
TO BE USED THEREIN

FIELD OF THE INVENTION

The present invention relates to a chip-on-glass (COG) assembly in which semiconductor chip(s) are bonded and connected to a substrate glass circuit board directly, especially that to be used, for example, for liquid crystal display, and to a connecting material to be used therein.

DESCRIPTION OF THE RELATED TECHNIQUES

In the past, liquid crystal displays (in the following referred to sometimes as LCD) are constituted by installing a semiconductor package, such as driver IC etc., on a substrate glass circuit board. However, from the recent general trend of fondness for light, thin, short and small articles, it has become to practise to produce liquid crystal displays by using a COG assembly made by assembling the semiconductor chip on a glass substrate board with direct connection thereto. In such a COG assembly, the correspondingly confronted electrodes on the substrate glass circuit board and on the chip are connected together using an anisotropically electroconductive connecting material (referred to in the following sometimes as ACM).

The ACM, which comprises, as the principal components, a thermosetting resin, such as epoxy resin

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etc., and electroconductive particles, is interposed between the glass circuit board and the semiconductor chip and the interposed layer of ACM is pressed from both sides with heating, whereby the thermosetting resin is first melted and is then subjected to curing. Here, the confronted electrodes are brought into pressed frictional contact with the electroconductive particles bridging therebetween to thereby establish a secure electroconductive connection, wherein the heat-set resin mass in the portions around such electrode pairs builds up firm mechanical bonding of the resulting assembly.

The adhesive strength of the ACM onto the substrate glass board or onto the chip is supported by the hardening contraction of the thermosetting resin, which may, however, cause occurrence of local stress concentration at the interface between the ACM and the substrate glass board or the IC chip. For attaining a high adhesive strength for the ACM, a thermosetting resin capable of building up a cured mass having higher elastic modulus may be chosen, which may bring about, however, greater hardening contraction and higher local stresses at the interfaces. While these local stresses remain as residual stress within the resin layer when the thickness of the substrate glass board is large, they may cause a deformation of the substrate glass board, such as warping or the like, when the glass board is thin.

On the general trend to light, thin, short and small articles in the market, the substrate glass board









strips is bound and connected with the semiconductor chip under intermediation with the interposed connecting material in such a manner that the electrodes on the substrate glass board are in a proper opposition to the corresponding counter electrodes of a form of, for example, bumps, of the semiconductor chip. Such a structure of the COG assembly is typical for LCD, while structures other than this may also be possible.

The connecting material according to the present invention comprises an adhesive component comprising a thermosetting resin and electroconductive particles. The connecting material is interposed between the elements to be connected together and the elements are pressed each other from both sides so as to cause the electrodes disposed opposingly on the confronting face of each element to be brought into contact with the electroconductive particles bridging between the elements, while holding the thermosetting resin between neighboring electrodes with the electroconductive particles dispersed therein. In this state, the connecting material is caused to harden in order to attain electric connection and mechanical bonding at the same time. The connecting material may contain other constituent ingredient(s) so that the tensile elongation percentage of the resulting cured material at 25 °C is not lower than 5 %. For such other ingredient, a microparticulate elastomer having an average particle size of 30 - 300 nm may favorably be incorporated.

As the main resin of the thermosetting resin to be incorporated according to the present invention in

the connecting material, any kind of resin capable of curing by a concurrent use of a hardening agent under the action of heat or irradiation of a ray, such as UV ray etc., may be used, for example, epoxy resins, urethane resins, phenol resins, hydroxyl group-containing polyester resins, hydroxyl group-containing acrylic resins and so on. Among them, epoxy resins are most preferable in view of the balance between the participant parameters, such as curing temperature, curing time, storage stability and so on of the resin.

As the epoxy resins, those of bisphenol type, those of epoxy-novolak type and those obtained from epoxy compounds having two or more oxirane groups in the molecule may be used. Commercial products of these epoxy resins may also be employed as such.

While the main resin of the thermosetting resin of the connecting material can be subjected to hardening usually by a concurrent use of a hardening agent, it is permissible to dispense with the use of hardening agent, when a substituent functional group facilitating the hardening reaction is present in the molecule of the main resin. As the hardening agent, there may be used those which can be subjected to the hardening reaction with the main component resin under the influence of heat or irradiation of a ray, for example, imidazoles, amines, acid anhydrides, hydrazides and dicyandiamides as well as modified products of them. Commercial products may also be employed. For such a hardening agent, preference is given to a latent hardening agent.

A latent hardening agent will not be subjected to a curing reaction during the processing operations and storage at normal temperature and upon drying at a relatively lower temperature (40 - 100 °C) but is subjected to a curing reaction under pressure with heating (heat-pressing) at a curing temperature or by the action of heat or irradiation of a ray, such as UV ray. For such a latent hardening agent, particular preference is given to one in which the above-mentioned hardening agent, such as an imidazole or an amine, is encapsulated in microcapsules, for which commercial products may also be employed. For heat-activated resins, those having a curing initiation temperature of 80 - 150 °C may favorably be employed.

As the microparticulate elastomer, a microparticulate product of natural or synthetic rubber having a T<sub>g</sub> of not higher than 50 °C, preferably not higher than 30 °C, and a rubbery elasticity at room temperature may be used, for example, a microparticulate product of natural rubber (NR), isoprene rubber (IR), butadiene rubber (BR), styrene/butadiene rubber (SBR), chloroprene rubber (CR) or acrylonitrile/butadiene rubber (NBR).

For this, cross-linked rubber is used, while a thermoplastic elastomer may also be used therefor, so long as its T<sub>g</sub> value is not higher than 30 °C. The average particle size of the microparticulate elastomer may favorably be in the range of 30 to 300 nm, preferably 50 to 200 nm. Also for the microparticulate elastomer, commercial products may be employed as such.



of 0 - 50 % by weight, preferably 5 - 30 % by weight, the microparticulate elastomer in an amount in the range from 6 to 90 % by weight, preferably from 8 to 30 % by weight, and other additive(s) in an amount of 0 - 10 % by weight, preferably 0 - 5 % by weight. The electroconductive particles may be admixed to the adhesive component in an amount in the range from 2 to 40 %, preferably from 5 to 25 %, based on the volume of the adhesive component.

The connecting material according to the present invention may be provided as a product in a form of a paste or of a film.

For preparing a paste of the connecting material, suitable constituent ingredients may be chosen to form a paste without using any solvent, while, in general, it is practical to formulate the paste by dissolving or dispersing the constituent ingredients in a suitable solvent. As the solvent, there may be used, for example, alcohols, ketones, esters, ethers, phenols, acetal and nitrogen-containing hydrocarbons, among which toluene, MEK, ethyl acetate and cellosolve acetate may be exemplified. The amount of the solvent to be used is, in general, about 20 - 40 % by weight, with respect to the weight of the resin components.

For preparing the connecting material in a form of a film, the above connecting material paste is coated on an exfoliative sheet in a layer, whereupon the solvent of the paste is volatilized to build up a film.

The connecting material according to the present invention may favorably be formulated from the above-

mentioned constituent ingredients so that the resulting connecting material after having been cured have a tensile elongation percentage at 25 °C of at least 5 %, preferably in the range from 6 to 20 %, by selecting suitable kinds and proportions of the constituent ingredients, whereby occurrence of warping of the resulting COG assembly can be minimized even if a thin glass board is used. In addition, the bonding strength and the reliability of secured electroconductive connection of the resulting COG assembly can be increased by selecting the constituent ingredients in such a way that the cured connecting material will have an elastic modulus at 30 °C in the range from 0.9 to 3 GPa, preferably in the range from 0.9 to 2 GPa, and a Tg of not lower than 100 °C, preferably in the range from 110 to 160 °C.

The concrete procedures for the determination of the above-mentioned characteristic properties are as follows:

- Tensile elongation percentage is determined by the method according to JIS K-7161.
- Elastic modulus is determined by DMA Method.
- Tg is determined as the temperature at the peak of  $\tan \delta$  on the determination of the elastic modulus.

The connecting material according to the present invention is interposed between two elements to be connected together, namely, a substrate glass circuit board and a semiconductor chip, each provided on the confronting face with a plurality of electrodes, while holding these elements in a posture in which the







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bonding layer reveals a higher adhesive strength to thereby suppress occurrence of deformation, such as warping or the like, even using a thin substrate glass board, on the one hand, and to obtain a connecting material which is superior both in the adhesive strength and in the reliability of electroconductive connection of electrodes, on the other hand, due to the inventive feature that the connecting material comprises a thermosetting resin and electroconductive particles and has, after having been cured, a tensile elongation percentage of at least 5 %.

#### THE BEST MODE FOR EMBODYING THE INVENTION

Below, the present invention will further be described by way of embodiments with reference to the drawings appended.

An embodiment of a COG assembly is shown in a schematic illustration in Figs. 1(a) and 1(b) showing the manner of assemblage and the resulting COG assembly, respectively, in which, on the substrate glass circuit board 1 having ITO layers 2 as the electrodes, a semiconductor chip 3 of, for example, a driver IC, having bumps 4 as the electrodes is installed. The electrodes, namely, the ITO layers 2 and the bumps 4 are disposed each at such a position as to confront to each other to constitute each confronting electrode pair. The connecting material 5 in a form of a film is interposed between the glass board 1 and the semiconductor chip 3, while holding them in such a relative





imidazole (a product of Asahi Chemical Industry Co., Ltd. with trade name HX-3941 HP), a microparticulate polybutadiene rubber (a product of Kuraray Co., Ltd., with an average particle size of 80 nm) as the microparticulate elastomer, an acrylic resin (a product of Fujikura Kasei Co., Ltd. with trade name SG 80, with a Tg of -25 °C) as the thermoplastic resin having a Tg of not higher than 50 °C, a phenoxy resin (a product of Tohto Kasei Co., Ltd. with trade name YP 50, with a Tg of 80 °C) as the thermoplastic resin having a Tg of higher than 50 °C, a commercial product of electric conductor-coated particles (a product of Nippon Chemical Industrial Co., Ltd. with trade name EH 20GNR, with an average particle size of 5  $\mu$ m) as the electro-conductive particles and toluene as the solvent, in a proportion as given in Table 1. The so-prepared paste was coated on an exfoliative film made of polyethylene terephthalate (PET), which have been subjected to an exfoliative surface treatment, up to a thickness which would result in a dry layer thickness of 40  $\mu$ m, whereupon the coating layer was placed in a hot air circulating furnace at 80 °C for 5 minutes, whereby a connecting material in a form of film was obtained.

#### Material Property Test

For determining the elastic modulus, the film coated with the uncured connecting material was cut into ribbons of a size of 6 cm  $\times$  0.2 cm, which were then subjected to curing at 180 °C for 15 minutes, whereupon the cured layer of the connecting material was peeled off from PET film for use as the testing

sample. For the testing, VIBRON DDV 01 FP (trade name) of the firm Orientec was used and the determination was carried out under the condition of a vibration frequency of 11 Hz, a temperature elevation rate of 3 °C per minute and a chuck-to-chuck distance of 5 cm.

The temperature at the peak of  $\tan \delta$  in the testing of the elastic modulus was determined as the Tg.

#### Tensile Test

For the tensile test, the film coated with the uncured connecting material was cut into ribbons of a size of 1 cm × 15 cm using a cutter knife, which were then subjected to curing at 180 °C for 15 minutes, whereupon the cured layer of the connecting material was peeled off from the film for use as the testing sample. For the testing, tensile tester AUTOGRAPH AGS-H and a video elongation meter of Model DVE-200 of Shimadzu Corp. were used and the determination of the tensile elongation percentage was carried out under the condition of a drawing speed of 1 mm per minute, a chuck-to-chuck distance of 10 cm, a calibration gauge length of 5 cm and a testing temperature of 23 °C.

#### Connection Test

The bump electrodes of an IC chip (made of silicon, with a size of 2 mm × 20 mm with a thickness of 0.55 mm, with gold-plated bumps each having a bump thickness of 20  $\mu$ m disposed at an interval of 80  $\mu$ m) were connected to corresponding electrodes on a 0.7 mm thick glass circuit board (a product of Corning with trade name 1737 F, with a size of 50 mm × 10 mm) under

intermediation by the connecting material of a form of film prepared as above. On the glass circuit board, ITO layers are disposed each at a position confronting to corresponding bump of the IC chip. On the glass circuit board, the IC chip was placed under intermediation with the connecting material film in such a manner that the bump and the ITO layer in each corresponding pair are in proper opposition to each other, as shown in Fig 1(a), whereupon the resulting assemblage was subjected to a heat pressing under a condition of  $200^{\circ}\text{C} \times 10 \text{ seconds} \times 98 \text{ N (10 kgf)}$  pressing force to obtain a COG assembly as shown in Fig. 1(b).

For this connection assembly, a 90° peeling strength was determined in accordance with the testing method of JIS K-6853 (Test for Peeling Strength of Adhesives) as the bonding strength.

For the reliability of the electroconductive connection, the connection resistance was determined by a so-called tetraterminal-method in which the connection resistance was determined initially and after standing for 1,000 hours under a condition of 85 °C and 85 % relative humidity, from which the average was taken over the determinations at 40 different portions of the detecting terminals.

### 《Determination of Amplitude of Warping》

For the COG assembly, the amplitude of warping of the glass surface after the heat pressing was detected using a surface roughness meter (supplied from the firm Kozaka Kenkyujo with trade name SE-3H) of a

probe needle contacting type by scanning the glass surface from beneath the glass board 1 of the COG assembly 10 as shown in Fig. 1(b) over the region of u shown in Fig. 1(a).

The results are recited in Table 1.

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Table 1

|  | Example |     |      |     | Comparative Example |      |     |
|--|---------|-----|------|-----|---------------------|------|-----|
|  | 1       | 2   | 3    | 4   | 1                   | 2    | 3   |
| <u>Adhesive component (wt. part)</u>   |         |     |      |     |                     |      |     |
| Epoxy resin A                          | 10      | -   | -    | 30  | 30                  | 25   | 20  |
| Epoxy resin B                          | 10      | 30  | 28   | -   | -                   | -    | -   |
| Hardening agent                        | 40      | 40  | 40   | 40  | 40                  | 40   | 40  |
| Micropartic. rubber                    | 10      | 10  | 12   | 10  | -                   | 5    | -   |
| Acrylic resin                          | -       | -   | -    | -   | -                   | -    | 10  |
| Phenoxy resin                          | 30      | 20  | 20   | 30  | 30                  | 30   | 20  |
| Electrocond. particles <sup>1)</sup>   | 12      | 12  | 12   | 10  | 12                  | 12   | 12  |
| <u>Material Property</u>               |         |     |      |     |                     |      |     |
| Elongat. percentage (%)                | 6.8     | 7.2 | 12.1 | 6.1 | 2.5                 | 3.6  | 3.7 |
| T <sub>g</sub> (°C)                    | 128     | 121 | 121  | 139 | 142                 | 128  | 134 |
| Elastic modulus (GPa)                  | 1.9     | 1.1 | 0.9  | 2.4 | 2.9                 | 1.9  | 2.1 |
| <u>Test Results</u>                    |         |     |      |     |                     |      |     |
| Amplitude of warp. (μm)                | 6.9     | 5.8 | 4.9  | 6.8 | 12.2                | 10.1 | 9.5 |
| Adhes. streng. (kgf/4mm <sup>2</sup> ) | 4       | 5   | 6    | 4   | 2                   | 2    | 3   |
| Initial resistance (Ω)                 | 13      | 13  | 13   | 13  | 13                  | 13   | 13  |
| Resist. aft. 1000 h (Ω)                | 16      | 17  | 19   | 16  | 23                  | 40   | 26  |

Note 1): In percent, based on the volume of the adhesive component.

From the results given in Table 1, it is seen that the connecting materials of Examples 1 to 4 show smaller amplitudes of warping with superior bonding performances and also superior results as to the reliability of the electroconductive connection. In contrast thereto, Comparative Examples 1 to 3, in which the features prescribed by the present invention are not satisfied, show greater amplitude of warping with inferior bonding strength and inferior electroconductive connection performances.

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## CLAIMS

1. A connecting material for bonding and connecting a semiconductor chip with the substrate glasss board in a COG assembly, in which the electrodes of the semiconductor chip are held in a direct connection with the corresponding electrodes on the substrate glass board, the said connecting material comprising

an adhesive component comprising a thermosetting resin and

electroconductive particles,

wherein the said material has, after having been cured, a tensile elongation percentage at 25 °C of at least 5 %.

2. The connecting material as claimed in claim 1, wherein the adhesive component comprises 6 - 90 % by weight of a microparticulate elastomer having an average particle size of 30 - 300 nm.

3. The connecting material as claimed in claim 1 or 2, wherein it comprises 2 - 40 %, based on the volume of the adhesive component, of the electroconductive particles.

4. A COG assembly, in which the electrodes of a semiconductor chip are held in a direct connection with the corresponding electrodes on the substrate glass board, comprising

a layer of a connecting material for bonding and connecting the semiconductor chip with the substrate board,

wherein the said material comprises an adhesive

component comprising a thermosetting resin and electroconductive particles and has, after having been cured, a tensile elongation percentage at 25 °C of at least 5 %.

5. The COG assembly as claimed in claim 4, wherein the adhesive component comprises 6 - 90 % by weight of a microparticulate elastomer having an average particle size of 30 - 300 nm.

6. The COG assembly as claimed in claim 4 or 5, wherein the connecting material comprises 2 - 40 %, based on the volume of the adhesive component, of the electroconductive particles.

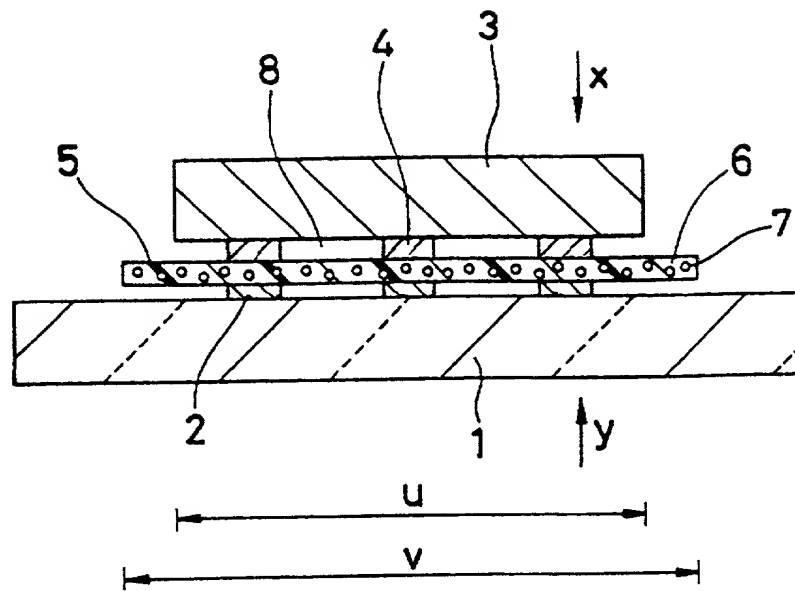
7. The COG assembly as claimed in any one of claims 4 to 6, wherein the COG assembly is a liquid crystal display.

## ABSTRACT

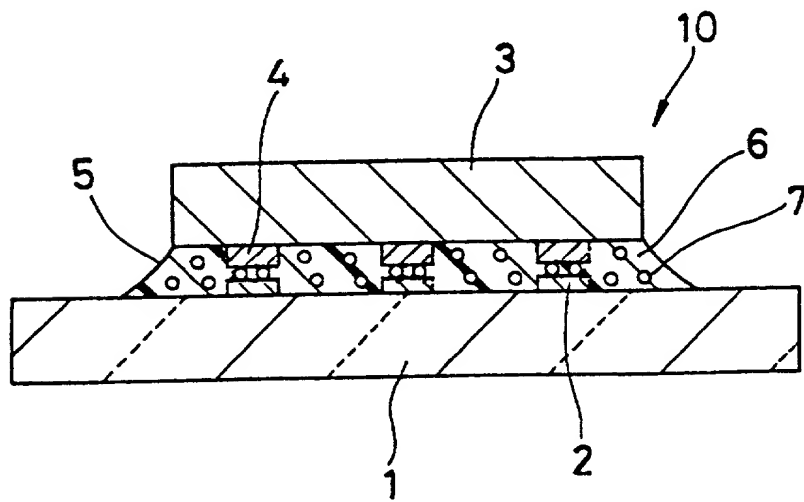
A chip-on-glass (COG) assembly, in which the electrodes of the semiconductor chips (3) are held in a direct connection with the corresponding electrodes on the substrate glass circuit board (1), comprising a layer (5) of a connecting material for bonding and connecting the semiconductor chip (3) with the substrate board (1), which material can attain reduced stress concentration at the boundaries between the binder layer (5) and the chip (3) and between the binder layer (5) and the glass board (1) even at higher adhesive strength, bringing about less deformation, such as warping, of the resulting bonded assembly even in the case of using a thinner substrate glass board, and provides a superior bonding strength and excellent electroconductive performance, wherein the said connecting material comprises, on the one hand, an adhesive component (6) containing a thermosetting resin and, on the other hand, electroconductive particles (7) and has a characteristic feature that a tensile elongation percentage at 25 °C, after having been cured, is at least 5 %.

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F i g. 1 (a)



F i g. 1 (b)



## DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled COG-ASSEMBLY AND CONNECTING MATERIAL TO BE USED THEREIN

\_\_\_\_\_, the  
specification of which (check X is attached hereto.  
one) \_\_\_\_\_ was filed on \_\_\_\_\_,  
as Application Serial No. \_\_\_\_\_ and was  
amended on \_\_\_\_\_.  
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

| Prior Foreign Application(s)            |  |   | Priority Claimed     |                     |
|---|--|---|----------------------|---------------------|
| <u>261096/1999</u><br>(Number)          | <u>Japan</u><br>(Country)                | <u>14/09/1999</u><br>(Day/Month/Year Filed)           | <u>X</u><br>Yes      | <u>      </u><br>No |
| <u>                    </u><br>(Number) | <u>                    </u><br>(Country) | <u>                    </u><br>(Day/Month/Year Filed) | <u>      </u><br>Yes | <u>      </u><br>No |
| <u>                    </u><br>(Number) | <u>                    </u><br>(Country) | <u>                    </u><br>(Day/Month/Year Filed) | <u>      </u><br>Yes | <u>      </u><br>No |

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

|   |  |   |
|---|--|---|
| <u>                    </u><br>(Application Serial No.) | <u>                    </u><br>(Filing Date) | <u>                    </u><br>(Status) (patented,<br>pending, abandoned) |
| <u>                    </u><br>(Application Serial No.) | <u>                    </u><br>(Filing Date) | <u>                    </u><br>(Status) (patented,<br>pending, abandoned) |

DOTFED-84455950

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

Dale H. Thiel (Reg. No. 24 323), David G. Boutell (Reg. No. 25 072), Ronald J. Tanis (Reg. No. 22 724), Terryence F. Chapman (Reg. No. 32 549) and Mark L. Maki (Reg. No. 36 589).

Send correspondence to: FLYNN, THIEL, BOUTELL & TANIS, P.C.  
2026 Rambling Road  
Kalamazoo, Michigan 49008-1699

Direct telephone calls to: (616) 381-1156

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor Motohide TAKEICHI  
Inventor's signature *Motohide Takeichi* August 24, 2000  
Date  
Residence Kanuma-Shi, Tochigi, Japan  
Citizenship Japan  
Post Office Address c/o SONY CHEMICALS CORPORATION  
12-3, Satsuki-Cho, Kanuma-Shi, Tochigi, 322-8502 Japan

Full name of second joint inventor, if any Hiroyuki FUJIHIRA  
Inventor's signature *Hiroyuki FujiHira* August 24, 2000  
Date  
Residence Kanuma-Shi, Tochigi, Japan  
Citizenship Japan  
Post Office Address c/o SONY CHEMICALS CORPORATION  
12-3, Satsuki-Cho, Kanuma-Shi, Tochigi, 322-8502 Japan

Full name of third joint inventor, if any \_\_\_\_\_  
Inventor's signature \_\_\_\_\_ Date \_\_\_\_\_  
Residence \_\_\_\_\_  
Citizenship \_\_\_\_\_  
Post Office Address \_\_\_\_\_

(Supply similar information and signature for fourth and subsequent joint inventors.)